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B62D 1/19

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B7B BSDA

(56) Documents Cited
GB 2326135 A GB 2309204 A GB 2279623 A
GB 1120799 A EP 0662414 A1

(58) Field of Search
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INT CL[6] B62D 1/19
Online: WPI

(54) Abstract Title
Impact absorbing steering column device

(57) An impact-absorbing steering column device comprises a steering column 1 which supports a rotable steering shaft 5, a bracket 35 which is secured to the body 3 of a car and supports the steering column 1 and, allows the steering column to move when an impact load of a predetermined value is applied thereon. An impact energy absorbing means 61 is provided between the steering column and the bracket 35 so as to absorb the impact energy when the steering column is moved. The impact energy absorbing means comprises an energy absorbing member 61 which is produced from metallic wire and has a latch portion 63 latchable by the bracket 35 and a portion 49 which is formed on the steering column for deforming the energy absorbing member when the steering column is moved.

FIG.2

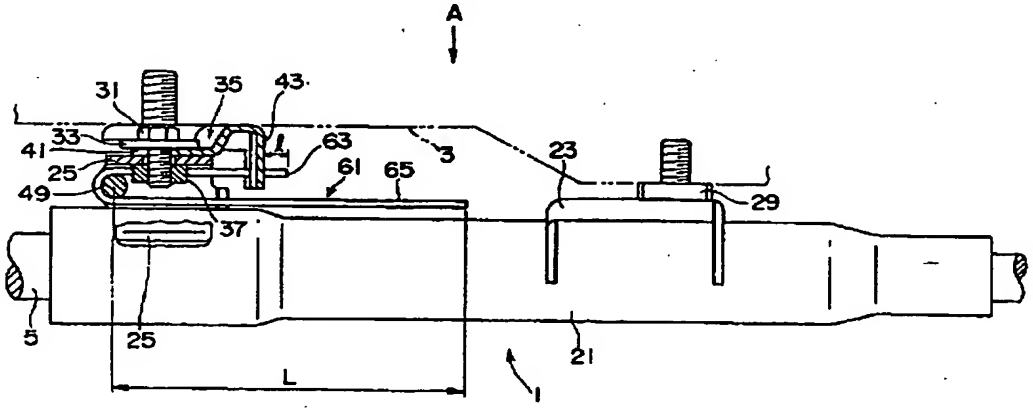

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FIG. 1

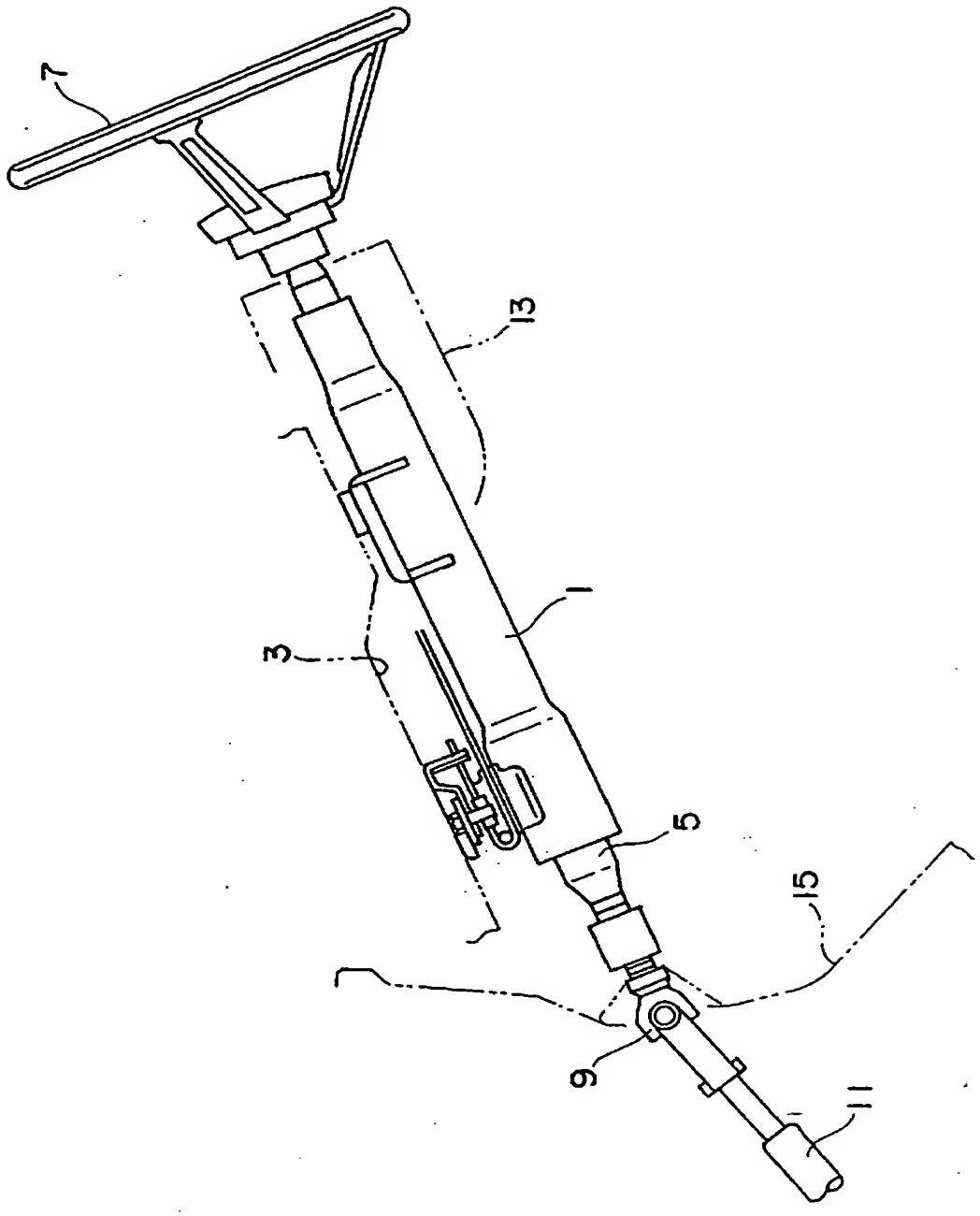


FIG.2

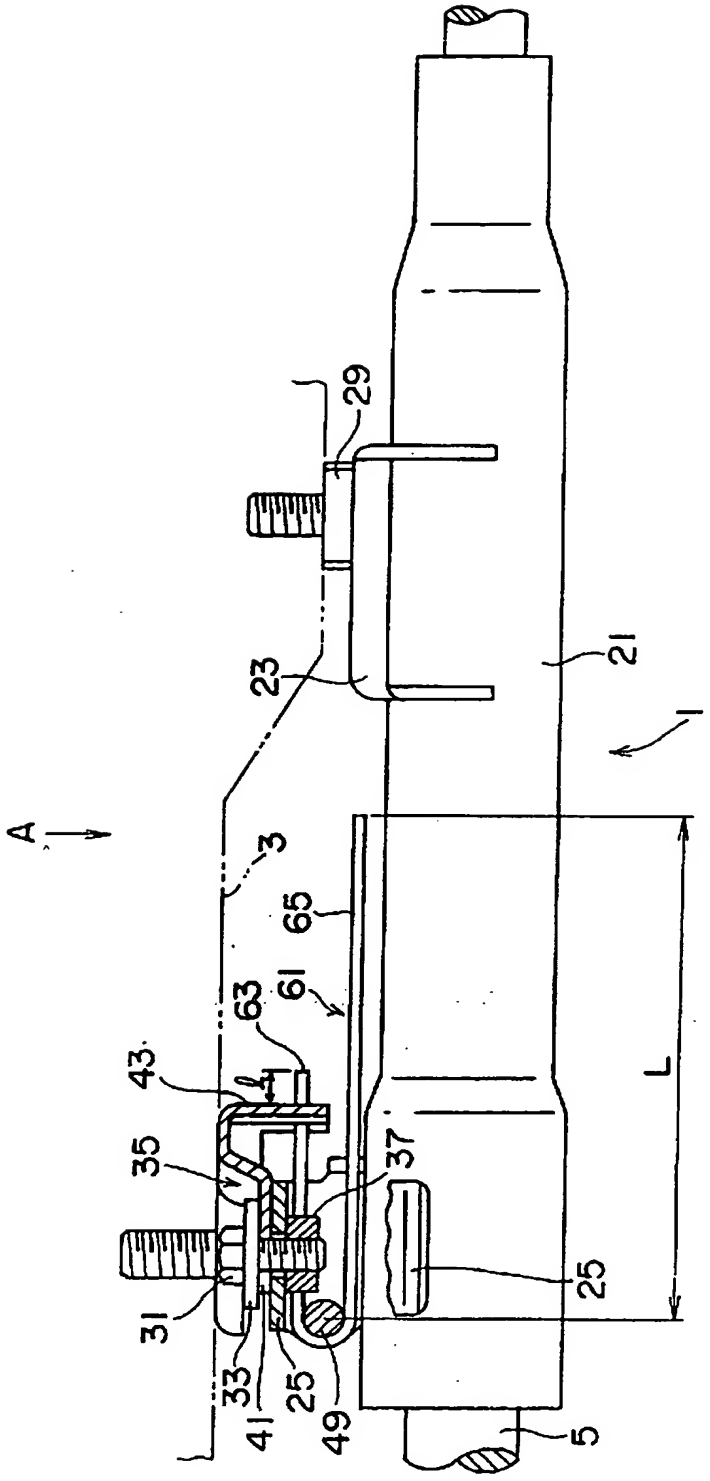


FIG. 3

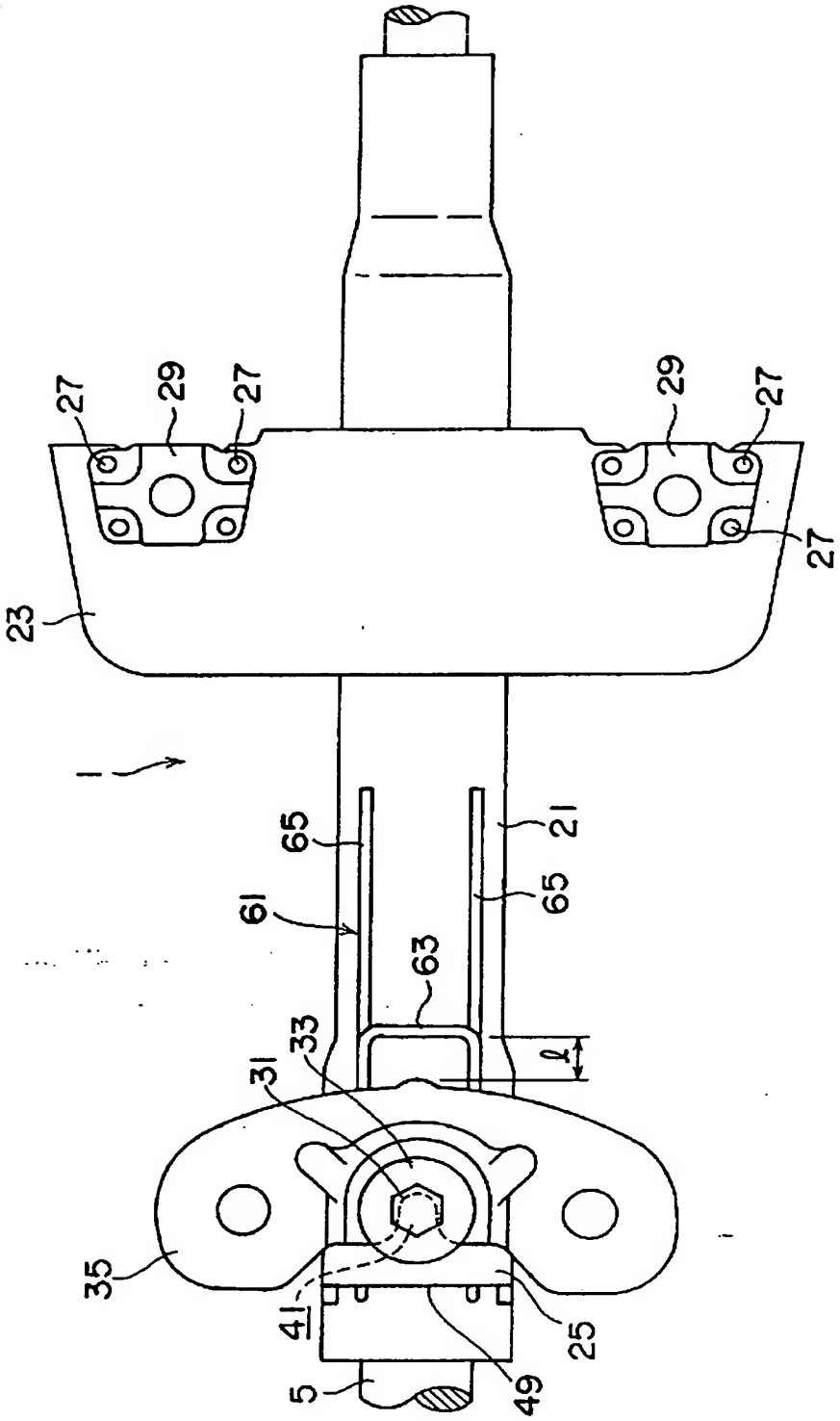
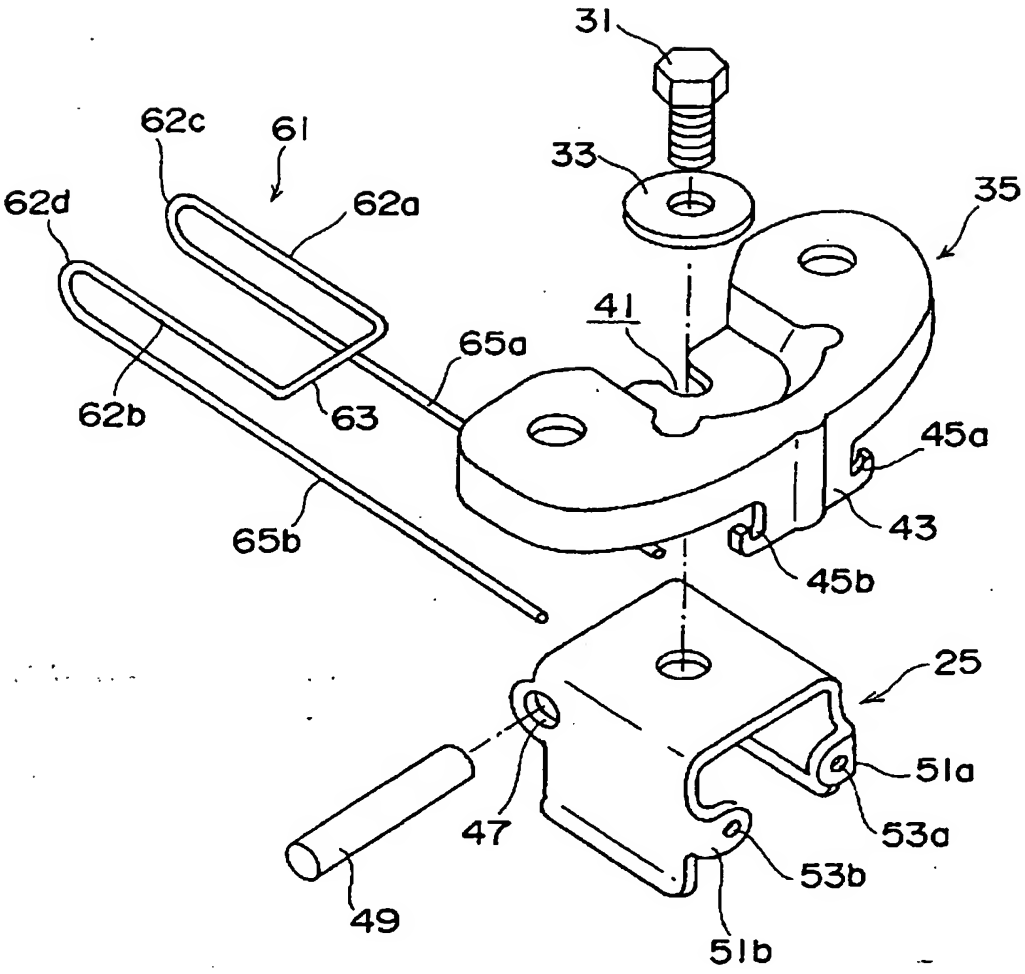


FIG. 4


31
33
35
62c
61
62d
62a
41
65a
62b
63
45a
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25
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47
53a
53b
49
51b

FIG.5

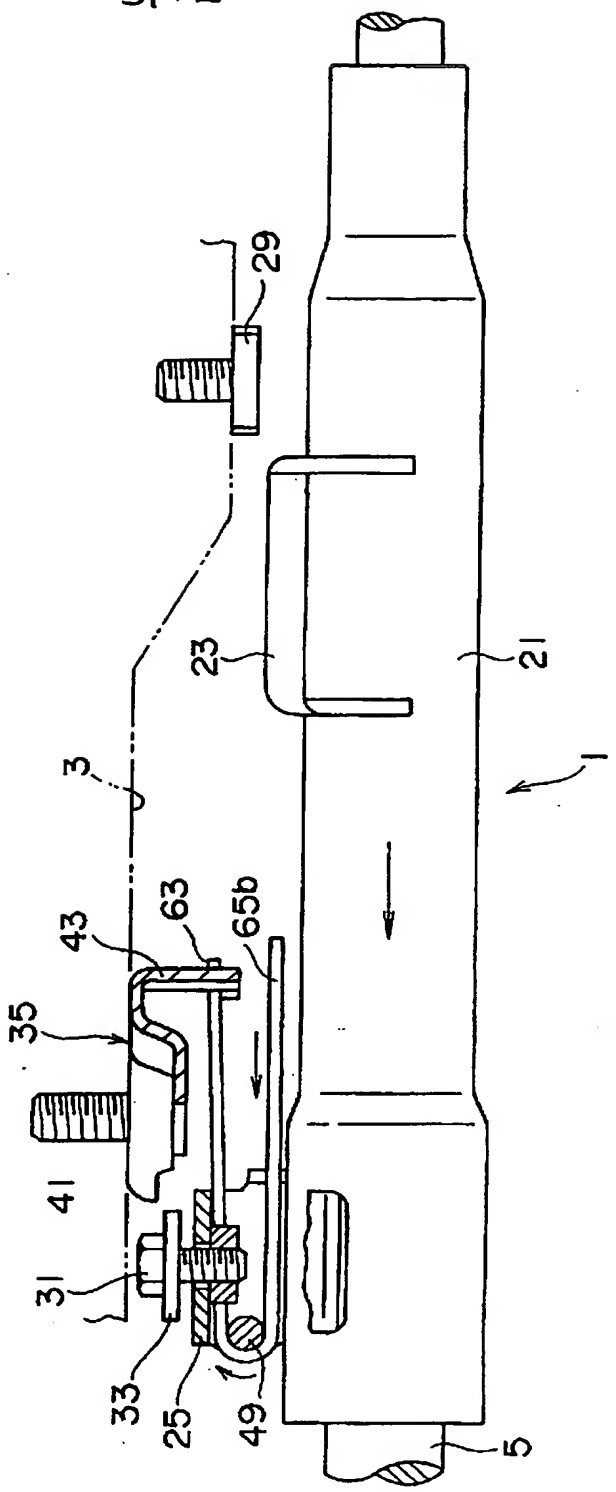


FIG.6

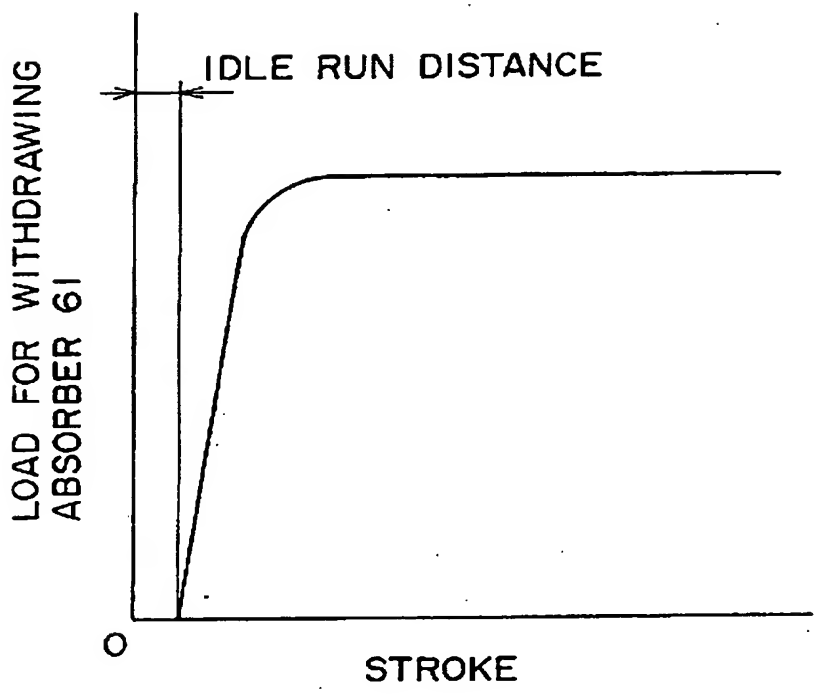

IDLE RUN DISTANCE
LOAD FOR WITHDRAWING ABSORBER 61
O
STROKE

FIG. 7

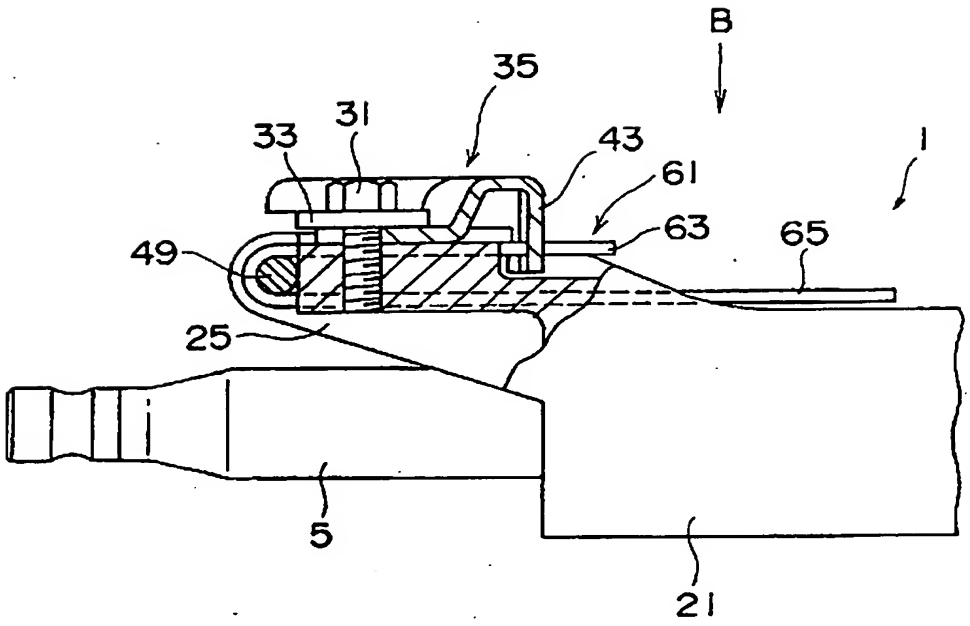


FIG. 8

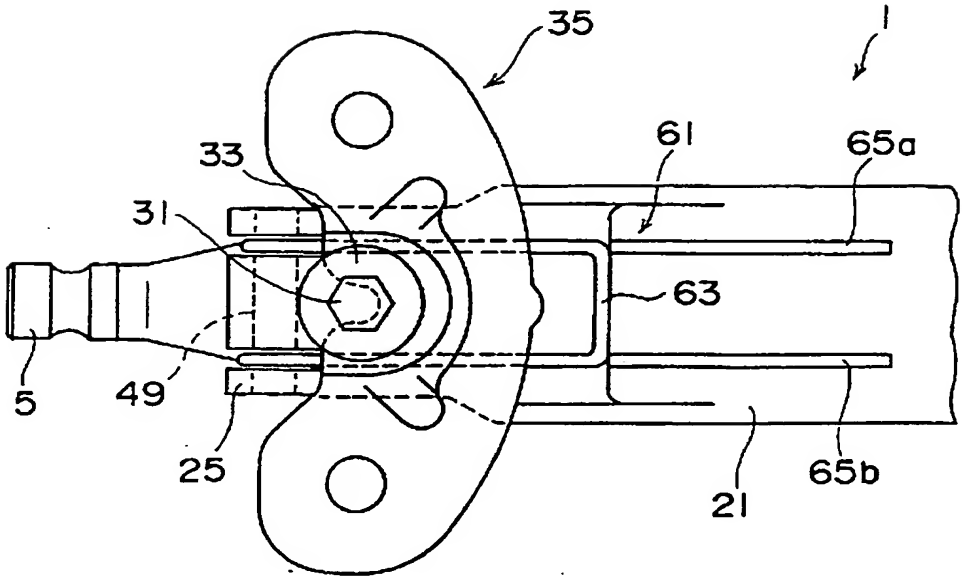


FIG. 9

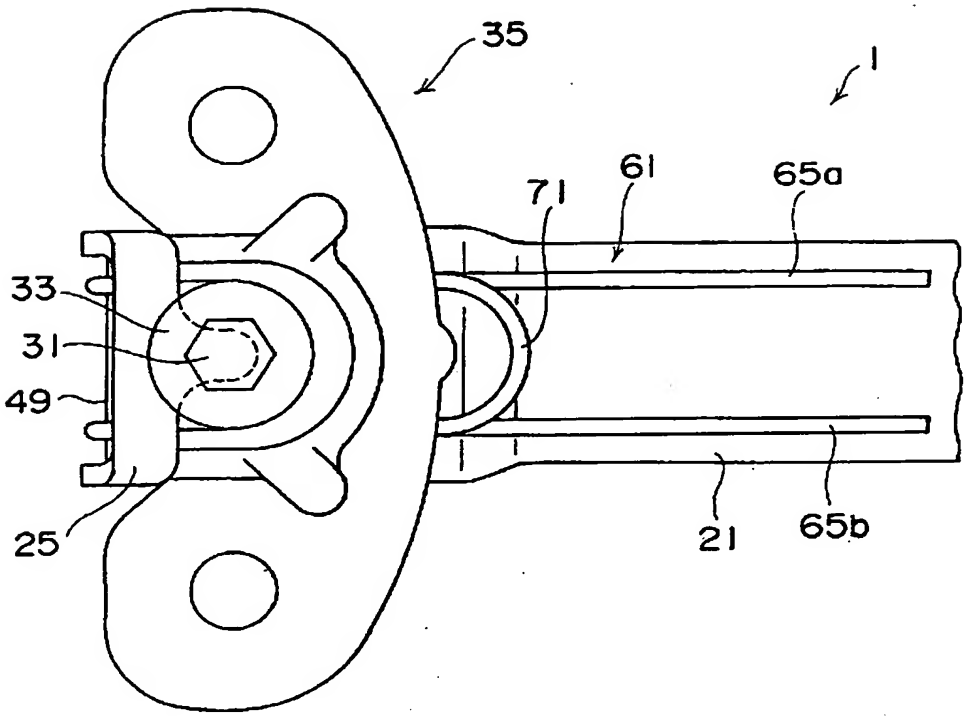


FIG. 10

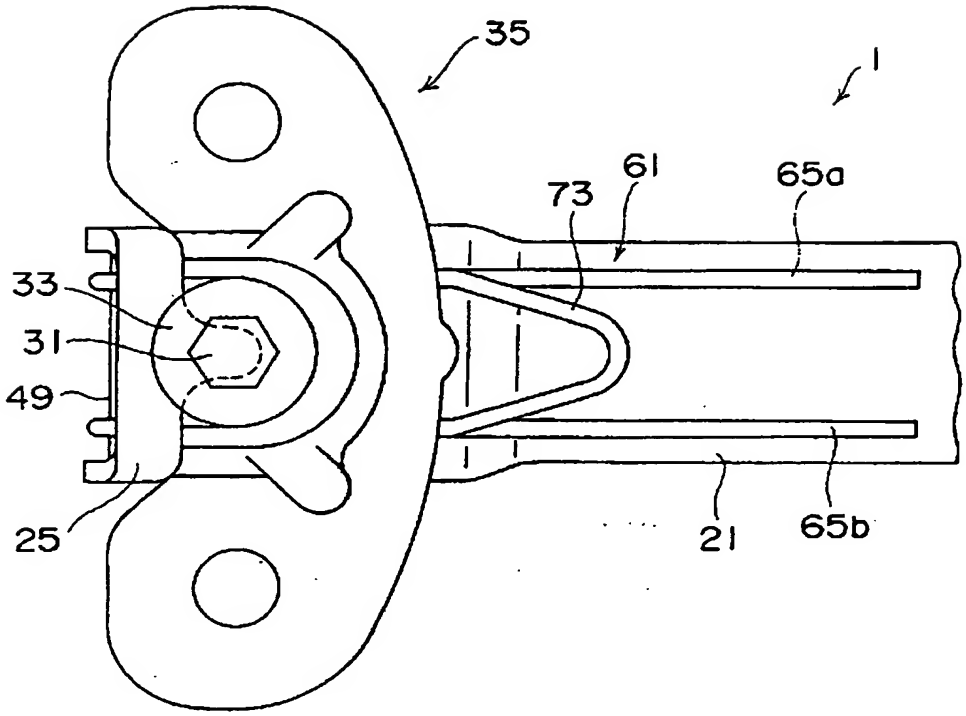


FIG. 11

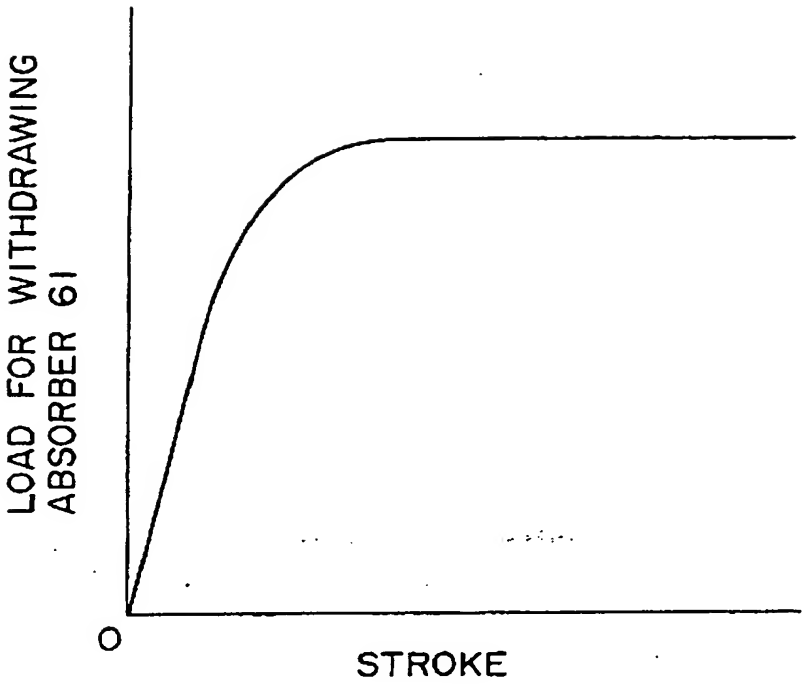
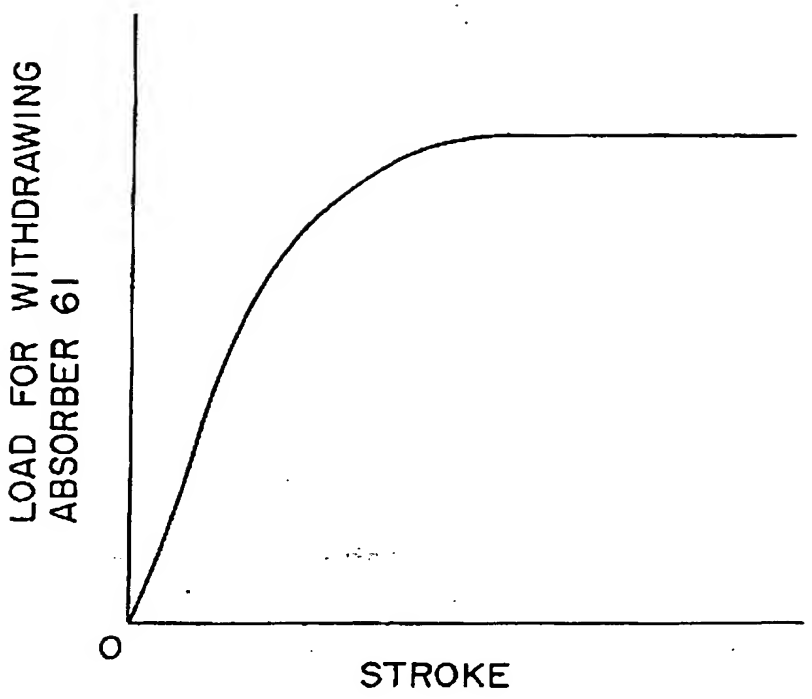


FIG. 12



IMPACT-ABSORBING STEERING COLUMN DEVICE

This application claims the benefit of Japanese Application No. 9-347359 which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an impact-absorbing steering column device, and more specifically, to a technology to reduce the manufacturing cost, facilitate setting of impact-absorbing characteristics of the device, etc.

Related Background Art

When a car collides with another car, a building, or the like, the driver in some cases comes into a secondary collision due to inertia and suffers serious damage to his head or chest. Recently, cars and automobiles largely employ, in order to avoid such trouble, an impact-absorbing steering shaft or an impact-absorbing steering column device. An impact-absorbing steering shaft is generally arranged such that the length of a steering shaft on the steering wheel side is reduced when the driver comes into a secondary collision. For this arrangement, the steering shaft is divided into an outer shaft and an inner shaft, and these shafts are engaged with each other to be mutually slidable by serration, etc. An impact-absorbing steering column device is arranged,

for example, such that a steering column falls off together with a steering shaft when the driver comes into a secondary collision. For this arrangement, plastic pins are generally used for connecting a bracket fixed to the car body (a dashboard or the like) (hereinafter called the body-side bracket) with the steering column so that the pins are broken due to the impact load at the time of the secondary collision and causes the steering column to fall off.

Normally, the impact-absorbing steering column device is provided with an impact absorbing means between the body-side bracket and the steering column so as to gradually absorb the impact energy after the steering column falls off. For example, Japanese Utility Model Application Laid-Open No. 5-75057 discloses such arrangement in which an impact energy absorbing member is interposed between an upper bracket for supporting an upper part of a steering column and the steering column and the impact energy absorbing member is elongated to be plastically deformed when the steering column moves forward. This impact energy absorbing member is formed by punching a steel plate into the form of a pantograph or a waveform, and the fore end of the impact energy absorbing member is welded to the steering column whereas the hind end thereof is locked by a pin inserted through the car body-side bracket. Also, in Japanese Patent Application Laid-Open No. 7-215221, there is disclosed

an impact energy absorbing member formed of a band-shaped steel plate, as well as another impact energy member punched from a steel plate and has a pleated elongated portion. The band-shaped steel plate has one end secured to the body-side bracket (or the steering column) and is drawn to be deformed by a drawing portion which is formed on the steering column side (or the body-side bracket) when the steering column is moved forward.

In the above-mentioned impact-absorbing steering column device, since the impact energy absorbing member is made of a steel plate, it requires a great cost to produce a press metal mold for punching the member. Also, since the weight per unit area of the steel plate is large, if an impact absorbing stroke is made large, the whole weight of the steering device also becomes large. Also, if the impact energy absorbing member is made in the form of a pantograph or wave form, a large amount of waste material is generated when the impact energy absorbing member is punched, so as to bring about a very poor yield of material. For the steering device in which an impact energy absorbing member is welded to a steering column or the like, the process of assembling the steering device contains a welding work, which inevitably causes a decline of the assembling workability and deterioration of the working environments. In addition, in a steering device of this type, it is desirable to set the impact absorbing characteristics freely, which, however, requires a great

cost when the specifications are altered, because a press metal mold is used for punching the impact absorbing member.

SUMMARY OF THE INVENTION

The present invention was conceived taking the above circumstances into consideration, and an object of the invention is to provide an impact-absorbing steering column device which is adapted to reduce the manufacturing cost and to facilitate setting of the impact absorbing characteristics.

The present invention proposes, in order to solve the above-mentioned problems, an impact-absorbing steering column device comprising a steering column which supports a steering shaft to be rotatable, a body-side bracket which is secured to the body of a car and supports the steering column and allows the steering column to fall off when an impact load of not less than a predetermined value is applied thereon, and an impact energy absorbing means which is provided between the steering column and the body-side bracket so as to absorb the impact energy when the steering column is moved, wherein the impact energy absorbing means comprises an energy absorbing member which is produced from metallic wire and has a latch portion latched by the body-side bracket and a drawing portion which is formed on the steering column for drawing and deforming the energy absorbing member when the steering column is moved.

According to the present invention, when the steering column falls off the body-side bracket and moves forward, the energy absorbing member is drawn and deformed by the drawing portion of the steering column, so as to absorb the impact energy at that time. Also, the impact absorbing characteristics can be easily set by properly altering the form or size of the energy absorbing member with a bending die.

Also according to the present invention, there is provided an impact-absorbing steering column device which comprises a steering column for supporting a steering shaft to be rotatable, a bracket device secured to the body side for supporting the steering column, so as to release the supported state of the steering column to allow the steering column to move when an impact load of not less than a predetermined value is applied thereon, and an energy absorbing device provided between the bracket device and the steering column so as to absorb the impact energy when the steering column is moved because of the load of not less than the predetermined value. The energy absorbing device comprises: a metallic wire which consists of first and second portions extending substantially in parallel and a connection portion integrally continuous to the first and second portions, in which the first and second portions are respectively extended to non-restraint end portions through bent back portions formed substantially equidistant from the

connection portion; a restraint portion which is secured to the car body for supporting the wire between the connection portion and the bent back portions so as to restrain the connection portion when the impact load is applied onto the wire; and a coupler which is secured to the steering column and is provided with a pin around which the bent back portions of the wire are wound and against which the bent back portions are born, whereby when the steering column is moved upon application of the impact load, said coupler is moved together with the steering column to move the wire by a predetermined distance through the pin so as to restrain the connection portion at the restraint portion, so that the first and second portions of the wire are drawn by the pin and are plastically deformed to absorb the impact load.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a view for explaining the structure of a steering device on the car interior side.

Fig. 2 is a side view for showing an impact-absorbing steering column device according to a first embodiment of the present invention.

Fig. 3 is a view seen from the direction of the arrow A in Fig. 2.

Fig. 4 is an exploded perspective view of a coupler, a lower bracket, and the like.

Fig. 5 is a view for explaining the mode of a function in the first embodiment.

Fig. 6 is a graph for showing the impact absorbing characteristics according to the first embodiment.

Fig. 7 is a side view for showing an impact absorbing steering column device according to a second embodiment of the present invention.

Fig. 8 is a view seen from the direction of the arrow B in Fig. 7.

Fig. 9 is a plan view for showing an essential structure of an impact-absorbing steering column device according to a third embodiment of the present invention.

Fig. 10 is a plan view for showing an essential structure of an impact-absorbing steering column device according to a fourth embodiment of the present invention.

Fig. 11 is a graph for showing the impact absorbing characteristics according to the third embodiment.

Fig. 12 is a graph for showing the impact absorbing characteristics according to the fourth embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the present invention will be described below with reference to drawings.

Fig. 1 is a side view for showing a steering device on the car interior side. Referring to Fig. 1, a reference numeral 1 denotes a steering column. The steering column 1 is secured to a car body 3 at two positions on upper and lower parts thereof, so as to support an upper steering shaft (hereinafter simply called the steering shaft) 5 to be rotatable by use of unrepresented bearings. The

steering shaft 5 is provided with a steering wheel 7 at the upper end thereof, and is connected with a lower steering shaft 11 at the lower end thereof through a universal joint 9. In Fig. 1, a reference numeral 13 denotes a column cover for covering the upper part of the steering column 1, and a reference numeral 15 denotes a dashboard for partitioning the car interior and an engine room.

With this steering device, when the driver rotates the steering wheel 7, a rotational force thereof is transmitted to an unrepresented steering gear through the steering shaft 5 and the lower steering shaft 11. The steering gear incorporates therein a rack-and-pinion mechanism, etc., for transforming the supplied rotational force into a rectilinear motion, so as to conduct a steering by altering the steering angle of the wheels through a tie rod. It should be noted that as this steering gear, in addition to a rack-and-pinion type steering gear, ball-screw type, warm roller type, and other various types of steering gears are known.

Fig. 2 is a side view of an impact-absorbing steering column device according to a first embodiment of the present invention, for showing a cross section of a part (the environs of the steering column 1) of the column device. On the other hand, Fig. 3 is a plan view for showing the same device (of a part seen from the arrow A in Fig. 2). As shown in these drawings, the steering

column 1 is assembled by welding an upper bracket 23 made of a steel plate to the upper part (on the right side of Figs. 2 and 3) of a column tube 21, and a coupler 25 which is also made of a steel plate to a lower part (on the left side of Figs. 2 and 3) of the same tube.

The upper bracket 23 is secured through eight plastic pins 27 in total to a pair of aluminum capsules 29 which are provided laterally and bolted on the car body 3. Also, the coupler 25 is secured through a bolt 31 and a washer 33 to a lower bracket 35 which is bolted on the car body and made of a steel plate, with a predetermined frictional force. In Fig. 2, a reference numeral 37 denotes a weld nut which is secured to the coupler 25. At the center of the lower bracket 35, there is formed an U-shaped notch 41 which opens forward, as shown in Fig. 3, and a shank of the bolt 31 is fitted in this U-shaped notch 41.

The lower bracket 35 is integrally provided with a latching piece 43 downward, as shown in Fig. 4 (an exploded perspective view of the coupler 25, the lower bracket 35, and the like), and this latching piece 43 is provided with a lateral pair of guide portions 45a, 45b. On the other hand, through holes 47 are formed at the fore ends of the both side walls of the coupler 25, and a drawing pin 49 made of steel is inserted through these through holes 47 for the juncture. Also, a pair of retaining pieces 51a, 51b are formed inward at the hind ends of the coupler 25, and retaining holes 53a, 53b are formed on these retaining

pieces 51a, 51b, respectively.

An absorber 61 which serves as an energy absorbing member is made of one plastically deformable steel wire. This steel wire is comprised of two linearly elongated portions 62a, 62b which are extending in parallel with the steering column and are substantially parallel with each other, and an angular U-shaped bent portion 63 which is connected to these linearly elongated portions 62a, 62b as a continuous integral structure. The angular U-shaped bent portion 63 is arranged in the rear of the latching piece 43 to oppose the latching piece 43 with a distance l therebetween, and the two linearly elongated portions 62a, 62b are retained and guided by the guide portions 45a, 45b of the latching piece 43 to be further extended forward. The two linearly elongated portions 62a, 62b are then wound around the pin 49 to be folded back at bent back portions 62c, 62d which are extended substantially perpendicular to the linearly elongated portions 62a, 62b, and then linearly extended substantially in parallel with the linearly elongated portions 62a, 62b for the second time, thereby constituting linear portions 65a, 65b. The linear portions 65a, 65b are respectively inserted through the retaining holes 53a, 53b to reach the non-restaint end portions. These linear portions 65a, 65b are extended backward from the axial center of the pin 49 over the length L, so as to constitute plastic deformation portions.

An operation of the first embodiment of the present invention will be described below.

When the driver comes into a secondary collision with the steering wheel 7 upon collision of a car, a large impact load is applied onto the steering column 1 through the steering shaft 5. As a result, the plastic pins 27 are sheared off and, as shown in Fig. 5, the upper bracket 23 and the aluminum capsule 29 are separated from each other. Then, the coupler 25, the bolt 31, and the washer 33 also overcome the frictional force with the lower bracket which is secured to the chassis and come out forward, whereby the steering column 1 is separated from the car body 3.

Since the steering column normally moves obliquely forward (the direction indicated by the arrow in Fig. 5) even after it is separated from the car body 3, the angular bent portion 63 is brought into contact with the rear portion of the latching piece 43 and is latched or detained there, when the absorber 61 is moved by a predetermined amount (the distance l) together with the coupler 25. Incidentally, the steering column 1 is moved (or runs idle) with no substantial resistance until the time at which the angular bent portion 63 is brought into contact with the latching piece 43, so that it becomes possible to properly set the energy absorbing characteristics by changing the distance l.

When the steering column is further moved, since the

U-shaped bent portion 63 of the absorber 61 is latched by the latch piece 43, the plastic deformation portion 65a, 65b are drawn by being sequentially wound around the drawing pin 49, as shown in Fig. 5, so as to absorb the impact energy by the plastic deformation. In this case, since the absorber 61 is made of steel wire, even if the direction, or the like, of the movement of the steering column 1 is slightly shifted, the absorber 61 can be easily flexed and gives no substantial influence on the impact absorbing characteristics. Fig. 6 is a graph for showing the impact absorbing characteristics in the first embodiment, which illustrates that, after the steering column 1 is moved by a predetermined idle distance, the impact energy is absorbed substantially correspondingly to an amount of the movement.

As described above, according to the first embodiment, the absorber 61 made of steel wire is used as the impact energy absorbing member so that it is possible to produce an impact-absorbing steering column device having excellent impact absorbing characteristics, while reducing the producing cost and the number of assembling steps therefor. It is also possible to arbitrarily set the idle run distance of the steering column 1 or an impact energy absorbing stroke by altering the distance l between the angular bent portion 63 and the latch piece 43 or the length L of the plastic deformation portion 65.

Fig. 7 is a side view for showing an impact absorbing

steering column device according to a second embodiment of the present invention, whereas Fig. 8 is a plan view for showing the same device (seen from the direction indicated by the arrow B in Fig. 7). As shown in these drawings, the second embodiment adapts substantially the same structure as that of the first embodiment. However, since the steering column 1 is formed of aluminum alloy by die casting, the column tube 21 and the coupler 25 are formed as an integral structure. According the second embodiment, the number of constituent parts and the number of assembling steps are reduced and a dimensional accuracy of the coupler 25 is enhanced.

Figs. 9 and 10 are plan views for showing the essential structures of impact-absorbing steering column devices according to third and fourth embodiments of the present invention. These embodiments adapt substantially the same structure as that of the first embodiment, except that the shape of the absorber 61 is altered in the both embodiments. More specifically, a portion which is brought into contact with by the latching piece 43 of the lower bracket 35 and latched there is an U-shaped bent portion 71 which is bent into the shape of U in the third embodiment, whereas the same portion is a V-shaped bent portion 73 which is bent into the shape of V in the fourth embodiment. As a result, idle run of the steering column 1 does not occur in the both embodiments, and the impact absorbing characteristics which fluctuate comparatively

smoothly can be obtained in the third embodiment, as shown in the graph of Fig. 11. On the other hand, the impact absorbing characteristics which fluctuate more smoothly can be obtained in the fourth embodiment.

Though the description of the preferred embodiments is thus concluded, embodiments of the present invention are not limited to those described above. For example, though it is arranged that the absorber is interposed between the lower bracket on the car body side and the coupler on the steering column side in the foregoing embodiments, it is possible to interpose the absorber between, for example, the capsule and the upper bracket. Also, it is arranged that the absorber is plastically deformed by one drawing pin which is secured to the coupler in the foregoing embodiments. However, it is possible to use a plurality of drawing pins, instead. It is also possible to dispose the drawing member in the coupler itself. Further, it is possible to properly alter a specific structure of the steering column device or a specific form, etc., of the impact energy absorbing member within the scope of the claims of the present invention.

As described above, in the impact-absorbing steering column device according to the present invention, there are provided the steering column for supporting the steering shaft to be rotatable, the body-side bracket which is secured to the car body side to support the steering column and, allows the steering column to fall

off when an impact load of not less than a predetermined value is applied thereon, and the impact energy absorbing means which is provided between the steering column and the body-side bracket so as to absorb the impact energy upon movement of the steering column. The impact energy absorbing means is formed of metallic wire and comprises the energy absorbing member having the latching portion which is latched at the body-side bracket, and the drawing portion formed on the steering column to plastically deform the energy absorbing member when the steering column is moved. As a result, it becomes very easy to set the energy absorbing characteristics. Also, it becomes possible to reduce the manufacturing cost and the weight of the steering column device.

WAHT IS CLAIMED IS

1. An impact-absorbing steering column device comprising:

a steering column which supports a steering shaft to be rotatable,

a body-side bracket which is secured to the body of a car and supports said steering column and allows said steering column to fall off when an impact load of not less than a predetermined value is applied thereon; and

an impact energy absorbing means which is provided between said steering column and said body-side bracket so as to absorb the impact energy when said steering column is moved,

wherein said impact energy absorbing means comprises:

an energy absorbing member which is produced from metallic wire and has a latch portion latched by said body-side bracket; and

a drawing member which is formed on said steering column for drawing and deforming said energy absorbing member when said steering column is moved.

2. An impact-absorbing steering column device comprising:

a steering column for supporting a steering shaft to be rotatable,

a bracket device secured to the body side of a car

for supporting said steering column, so as to release the supported state of said steering column to allow said steering column to move when an impact load of not less than a predetermined value is applied thereon, and

an energy absorbing device provided between said bracket device and said steering column so as to absorb the impact energy when said steering column is moved because of the load of not less than the predetermined value,

wherein said energy absorbing device comprises:

a metallic wire which consists of first and second portions extending substantially in parallel and a connection portion integrally continuous to said first and second portions, said first and second portions being respectively extended to non-restraint end portions through bent back portions formed substantially equidistant from said connection portion;

a restraint portion which is secured to the car body for supporting said wire between said connection portion and said bent back portions so as to restrain said connection portion when the impact load is applied onto said wire; and

a coupler which is secured to said steering column and is provided with a pin around which said bent back portions of said wire are wound and against which said bent back portions are born,

whereby when said steering column is moved upon

application of the impact load, said coupler is moved together with said steering column, and moves said wire by a predetermined distance through said pin so as to restrain said connection portion at said restraint portion, so that said first and second portions of said wire are drawn by said pin and are plastically deformed to absorb the impact load.

3. An impact-absorbing steering column device according to Claim 2, wherein said restraint portion supports said first and second portions of said wire at a position between said connection portion and said bent back portions.

4. An impact-absorbing steering column device according to Claim 2, wherein said connection portion substantially constitutes a part of the U shape.

5. An impact-absorbing steering column device according to Claim 2, wherein said bent back portion substantially constitutes a part of the V shape.

6. Steering apparatus comprising a steering column and a wire, or rod, member through which said steering column is connectable to a vehicle body, the arrangement being such that, in use said wire, or rod, member deforms to absorb an impact to said steering column above a predetermined amount.

7. Steering apparatus or a steering column device substantially as herein described with reference to: Figures 1 to 5; or Figure 1 as modified by Figures 7 and 8, Figure 9 or Figure 10.

The Patent Office — 20

Application No: GB 9825858.5
Claims searched: 1-7

Examiner: Peter Corbett
Date of search: 10 March 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): B7B (BSDA)

Int Cl (Ed.6): B62D 1/19

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X,E	GB 2326135 A	(NASTECH EUROPE) see Fig 2	1,6
X	GB 2309204 A	(NSK) see Fig 1	6
X	GB 2279623 A	(TORRINGTON) see Figs 5 and 6	1,6
X	GB 1120799	(FORD) see Fig 10	6
X	EP 0662414 A1	(NACAM) see Figs 3 and 4	6

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.